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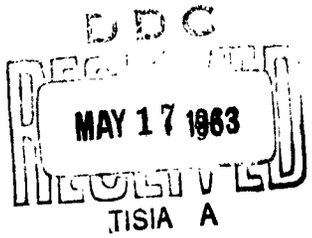
CONSTRUCTION OF A MODIFIED HENDERSON APPARATUS

by
J. F. Pribnow
M. S. Silverman



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MICROBIOLOGY AND IMMUNOLOGY BRANCH
M. S. Silverman, Head

BIOLOGICAL AND MEDICAL SCIENCES DIVISION
E. L. Alpen, Head

ADMINISTRATIVE INFORMATION

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Eugene P. Cooper
Eugene P. Cooper
Scientific Director

E. B. Roth
E. B. Roth, CAPT USN
Commanding Officer and Director

ABSTRACT

An apparatus for exposing mice to an aerosol of microorganisms has been developed. It is a modification of the Henderson apparatus, adapted for exposure of smaller animals. The design allows for placement of the complete apparatus in a bacteriological hood. Although of relatively simple design and operation, it has proven highly dependable.

SUMMARY

The Problem

To develop an apparatus for exposing mice to an aerosol of microorganisms. The apparatus should be of relative simplicity of design, and small enough to be placed in a bacteriological hood.

The Findings

A modified Henderson apparatus was designed for exposing mice in groups of up to 40 animals. Because of its basic design, the apparatus could be placed in a bacteriological hood, and has proven both reliable and serviceable.

INTRODUCTION

The apparatus originally described by Henderson (1) is used to generate an aerosol of microorganisms. The microorganisms, mixed with air, flow past the experimental animals to sample collecting stations. This apparatus was too large to be placed in a bacteriological hood, of elaborate design, and not adaptable for use with animals as small as mice.

The modification described in this report was developed to expose mice, which had received continuous low level gamma radiation, to varying doses of the microorganism, Listeria monocytogenes. The apparatus is relatively small, easy to operate, and has proven very serviceable.

PHYSICAL DESCRIPTION

The components of the apparatus are shown in Fig. 1. They consisted of a pressure pump, a Wells atomizer, mixing chamber, animal exposure chambers, air samplers, and a vacuum pump.

The Wells atomizer (2), an internal spray type, was made of glass, and utilized a peripheral fluid jet nozzle.

The mixing chamber consisted of an air mixing section and an additional aerosol mixing section. The air mixing section was a

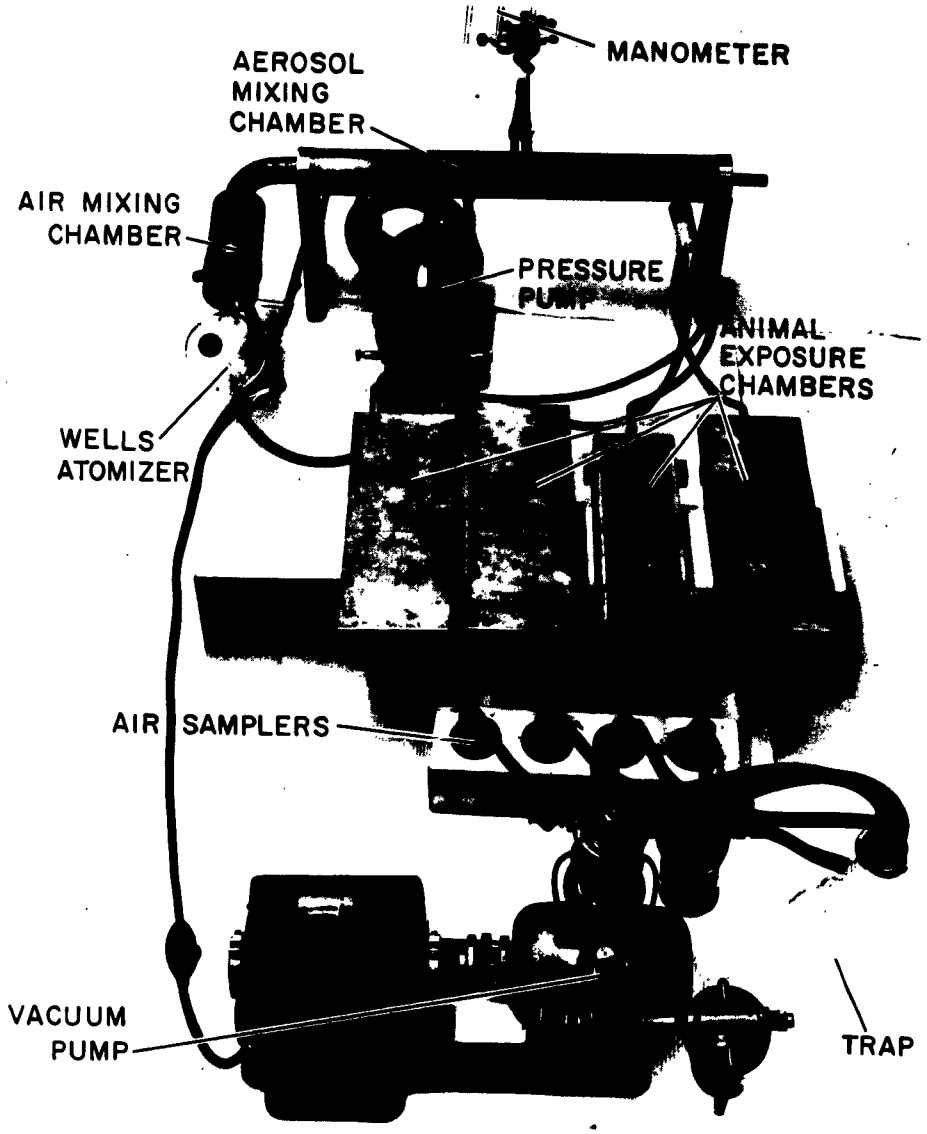

Fig. 1 Modified Henderson apparatus for respiratory infection of mice.

brass tube 2 3/4 inches in diameter and 6 3/4 inches long. Two atmospheric inlets were located at the top and bottom of the tube 1/2 inch from the intake end. The aerosol mixing chamber was a copper tube 2 1/4 inches in diameter and 24 inches long. A water manometer was connected to the top of the section. The two sections were connected by 90° angle copper tubing.

Chambers for animal exposure consisted of air tight cast aluminum rectangular boxes 11 inches long, 2 1/2 inches deep and 3 1/8 inches wide (inside measurement). To insure an air tight fit, a rubber gasket was permanently affixed to the outer perimeter of the cover. The aerosol inlet and outlet located at either end were protected from the animals by use of baffles. Placing of the animals in the exposure chamber was facilitated by construction of boxes from 1/4 inch mesh wire screening hardware cloth. These boxes, which fit inside the exposure chamber, were hinged at one end, thus providing a small opening for inserting or removing mice. The chambers could hold up to ten mice each, and the apparatus accommodated four such chambers.

The air sampler consisted of metal impingers supplied through the courtesy of Mr. W. R. Leif of the U. S. Naval Biological Laboratory, Oakland, California. The sampler was made from a piece of 5 inch stainless steel tubing (outside diameter 1/4 inch). On the bottom end was soldered a 1/32 inch plate with a critical

orifice made by use of a #66 drill. The impinger flow rate was 6.00 ± 0.048 liters per minute. The sampler collection bottles were four ounce French Square bottles.

The air pressure pump, Model 1032 A, and the vacuum pump, Model 1033 S, were obtained from the Arthur B. Thomas Co., P. O. Box 779, Philadelphia 5, Pa.

OPERATION

The standard operating procedure for this apparatus was as follows:

a. The Wells atomizer was filled with 50 ml brain heart infusion broth culture of the test organism.

b. Ten mice were placed in each exposure chamber.

c. Air sampler bottles were filled with 10 ml of 1% tryptose broth plus 3 drops of Dow Corning Antifoam B. The impinger orifice was positioned 1 inch from the bottle bottom.

d. To air wash the animals, the vacuum pump was activated for about 45 seconds before starting the pressure pump. The manometer indicated a slight pressure differential. After the desired run time, the pressure pump was stopped about 45 seconds before the vacuum pump.

e. Plate counts of serial dilution of the broth in the sampler bottles were made. The number of organisms each

mouse received was obtained by the following calculation:

$$\frac{\text{Sampler count X ml of collecting fluid}}{\text{impinger flow rate X exposure time}} = \frac{\text{organisms}}{\text{liter}}$$

$$\frac{\text{Organisms}}{\text{liter}} \times 1.25 \times 10^{-3} \text{ X weight of mouse X exposure time} = \frac{\text{organisms}}{\text{mouse}}$$

$1.25 \text{ X } 10^{-3}$ = average value for respiratory volume of mouse expressed in liter per minute per gram body weight (4).

SAFETY PRECAUTIONS

Because of the pathogenic nature of the test organism, operation of the apparatus was carried out in a bacteriological hood. The hood was vented to the outside atmosphere through a series of bacteriological glass fiber filters. Air drawn through the same filter system was removed to maintain a negative pressure in the laboratory room. Operating personnel wore a standard Navy B W gas mask and protective clothing, as it was necessary to open the hood to exchange mice and samples.

CONCLUSIONS

The modified Henderson apparatus described has proven highly satisfactory for exposing up to 40 mice to an aerosol of microorganisms. Its compact design allowed it to be placed in a bacteriological hood, thus providing protection to the operating personnel. Operation over a period of two year has demonstrated that this is a very serviceable and dependable design.

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